

I profited by my short residence in Setubal to inquire whether there were other specimens of *Hyalonema* in the possession of any inhabitant of that town, and I had the good fortune to find one in a good state of preservation, belonging to a proprietor of fishing-boats, Antonio Avelino, who generously gave it to me. This individual, which brings up to twelve the number of *Hyalonemas* observed by me, was fished in April of the present year, by the padrone Manuel de Souza the younger.

After this exposition of the facts, the correctness of which I guarantee, I hope there will no longer be any pretext for doubting the habitat which I have assigned to *Hyalonema lusitanicum*.

As to regarding the *Hyalonemas* as artificial products of the industry of the Japanese, this is an hypothesis so destitute of proof that it seems to me useless to discuss it here. I will only renew the declaration which I have already made to you with regard to the cotton thread which Professor Ehrenberg supposes to exist twisted round the filaments beneath the corium poly-pigerum. *I maintain that this supposed thread does not exist either in the specimen I have presented to the British Museum, or in any of those in the Museum at Lisbon.*

I authorize you to make what use you please of this letter, as also of my preceding one.

Accept, &c.,

J. V. BARBOZA DU BOCAGE.

## PROCEEDINGS OF LEARNED SOCIETIES.

### ROYAL SOCIETY.

May 2, 1867.—Lieut.-General Sabine, President, in the Chair.

“On the Genera *Heterophyllia*, *Battersbyia*, *Palæocyclus*, and *Asterosmilia*, and their Position in the Classification of the Sclerodermic Zoantharia.” By Dr. P. M. DUNCAN, Sec. G.S.

Although the practical and natural classification of the Madreporaria (Sclerodermic Zoantharia) which has been submitted by MM. Milne-Edwards and Jules Haime is very generally admitted to be the best, still there are great gaps in the succession of the genera, and, moreover, some genera cannot be placed.

The “break” between the Turbinolides and the Astræides is so great as to render the classification rather artificial; but Dr. Duncan’s discovery of a genus *Asterosmilia*, comprising several species, unites these great divisions. The new genus has the peculiarities of the *Trochocyathi*, but in addition it is furnished with an endotheca. The species are described.

The genera *Heterophyllia*, McCoy, and *Battersbyia*, Milne-

Edwards and Jules Haime, are amongst those *incertæ sedis*. The discovery of several new species of *Heterophyllia* enables Dr. Duncan to determine the anatomy of the genus, to offer for consideration the most extraordinary coral form he has ever seen, and to ally the genus with *Battersbyia*, which he proves had no cœnenchyma. The species of both of the genera are described shortly, and the development and reproduction of *B. gemmans* also. The genera are placed amongst the Astræidæ.

The genus *Palæocyclus*, M.-E. & J. H., supposed to be one of the Fungidæ, is proved to be a vesiculo-tubulate coral genus, and to be one of the Cyathophyllidæ.

One Mesozoic family is therefore removed from the Palæozoic coral-fauna, and two genera of a Mesozoic division are introduced. They foreshadow the *Thecosmiliæ* of the Trias.

“Contribution to the Anatomy of *Hatteria* (*Rhynchocephalus*, Owen).” By ALBERT GÜNTHER, M.A., Ph.D., M.D.

The skull of *Hatteria* is distinguished by the following characters :—

1. Persistence of the sutures, especially of those between the lateral halves of the skull, combined with great development of its ossified parts—a development which appears in the expanse of the bones forming the upper surface of the facial portion, in the completeness of an orbital ring with a temporal and zygomatic bar (Crocodilia), in the much expanded columella, in the nearly completely osseous bottom of the orbit, and roof of the palate.

2. Sutural union of the tympanic with the skull; firm and solid union of the bones of the palate with the tympanic, as shown by the sutural connexion of tympanic and pterygoid, broad sutural connexion of the columella with tympanic and pterygoid, immoveable pterygo-sphenoid joint, firm and extensive attachment of pterygoid to ectopterygoid.

3. This restriction of the mobility of the bones named is compensated by an increased and modified mobility of the lower jaw, the mandibles being united by ligament, and provided with a much elongated articular surface.

4. Displacement of the palatine bones, which are separated by the pterygoids, and replace a palatal portion of the maxillaries.

5. Perforation of the tympanic; extremely short postarticular process of the mandible.

The vertebral column and the remainder of the skeleton show the following peculiarities :—

1. Vertebræ amphicœlian; caudal vertebræ vertically divided into two equal halves. Points of minor importance are the uniform development of strong neural spines, and the direction of the caudal pleurapophyses, which point forwards.

2. The costal hæmapophyses are modified, first, into a series of appendages identical in position with the uncinatè processes of birds; and, secondly, into a double terminal series connecting the

ribs with the thoracic and abdominal sterna, the distal pieces being much dilated and forming the base of a system of muscles (retractors of the abdominal ribs).

3. The development of a system of abdominal ribs, standing in intimate and functional relation to the ventral integuments.

4. Continuity of the ossification of the coracoid; presence of an acromial tuberosity of the scapula; subvertical direction of the os ilium.

5. The arrangement of the bones of the limbs and their muscles does not show any deviation from the Lacertian type.

The *dentition* of *Hatteria* is unique. That of young examples differs scarcely from the dentition of other acrodont lizards. In adult examples the intermaxillaries are armed with a pair of large cutting-teeth; a part of the lateral teeth are lost; and the alveolar edges of the jaws are cutting and highly polished, performing the function of teeth. A series of palatine teeth is in close proximity and parallel to the maxillary series, both series receiving between them in a groove the similarly serrated edge of the mandible.

As regards the *organs of sense*, the absence of the pecten of the eye and of the tympanic cavity, the commencement of a spiral turn of the cochlea, and the attachment of the hyoid bone to the terminal cartilage of the stapes are to be noticed.

The structure of the *heart* and of the organs of *respiration* and *circulation* are of the Lacertian type.

The *absence of a copulatory organ* is a character by which *Hatteria* is distinguished from all other Saurians. Thus *Hatteria* presents a strange combination of elements of high and low organization, and must be regarded as the type of a distinct group. Its affinities and systematic position may be indicated in the following

#### *Synopsis of Recent Reptilia.*

##### I. SQUAMATA.

First order. *Ophidia*.

Second order. *Lacertilia*.

Suborder A. *Amphisbænoidea*.

Suborder B. *Cionocrania*.

Suborder C. *Chamæleoidea*.

Suborder D. *Nyctisaura*.

Third order. *Rhynchocephalia*.

##### II. LORICATA.

Fourth order. *Crocodilia*.

##### III. CATAPHRACTA.

Fifth order. *Chelonia*.

May 9, 1867.—Lieut.-General Sabine, President, in the Chair.

“On the Development and Succession of the Teeth in the Marsupialia.” By WILLIAM HENRY FLOWER, F.R.S., F.R.C.S.

Although the dentition of adult individuals of all the animals which constitute the remarkable Order or, rather, Subclass Marsupialia



has been repeatedly subjected to examination, and described with exhaustive minuteness of detail, it is a singular circumstance that most of those peculiarities in the succession of their teeth which distinguish them from other mammals appear hitherto to have escaped observation. To supply this blank is the object of the present communication. Fortunately the materials at my disposal, although not quite so complete as might be desired, are yet amply sufficient to illustrate the main aspects of the question, and to supply a result as interesting as it was unexpected.

Descriptions are given in the paper, accompanied by drawings, of several stages of the dentition of members of each of the six natural families into which the order is divided.

1. *Macropodidæ*.—The dentition of the Kangaroo (genus *Macropus*), from the completely edentulous fœtus to adult age, is described in detail. Contrary to what has been specially stated with regard to this genus, there are no deciduous or milk-incisors, the teeth of this group which are first formed and calcified in both jaws being those which are retained throughout the life of the animal. The rudimentary canine and first premolar have also no deciduous predecessors. The second tooth of the molar series (a true molar in form) is vertically displaced by a premolar. The four true molars have, as has long been known, no deciduous predecessors. There is thus but one tooth on each side of each jaw in which the phenomenon of diphyodont succession occurs. The period at which this takes place varies in different species of the family. In some forms of *Hypsiprymnus* the successional premolar is not cut until after the last true molar is in place and use,—this probably having relation to the extraordinary size of the tooth, and the time consequently required for its development. A special characteristic of this family is the tendency to lose the canine and one or both premolars at a comparatively early period of life.

2. *Phalangistidæ*.—Several early stages of the dentition of *Phalangista vulpina* are described and figured. In a young specimen in which no teeth had cut the gum, the crowns of the permanent incisors, canine, and first two molars were found to be calcified, and the germ of the permanent premolar was already formed beneath the milk- or deciduous molar, which, as in *Macropus*, is the only tooth which is shed and replaced by a successor. The change takes place at an earlier period than in the last family.

3. *Peramelidæ*.—No very early stages of *Perameles* were examined; but adolescent specimens of this genus and of *Chaeropus* show that a very minute, compressed, molariform tooth is replaced by the triangular, pointed, third or posterior premolar. No other signs of vertical displacement and succession were observed.

4. *Didelphidæ*.—In the American genus *Didelphys*, the observations are complete from the earliest stage, and show that, as in the Australian *Macropodidæ* and *Phalangistidæ*, none of the teeth of the permanent series have predecessors except the compressed pointed last premolar, which replaces a tooth having the broad multicuspitate crown of a true molar.

This change does not occur until the animal approaches the adult age.

5. *Dasyuridæ*.—In a foetal *Thylacinus*, in which no teeth had cut the gum, the crowns of the permanent incisors, canines, premolars, and anterior true molars were partially calcified, and necessarily much crowded together in the jaw. A very minute rudimentary molar was situated just beneath the alveolar mucous membrane, superficially to the apex of the hindermost premolar, and was evidently its milk-predecessor.

6. *Phascolomyidæ*.—This family is placed last because the observations regarding it are less complete than in the case of any of the others. The youngest Wombat available presented no evidence of succession of any of the teeth; but it is probable that the single premolar is preceded by a milk-molar, at a still earlier period than any examined.

From the foregoing observations it may be concluded with tolerable safety that the animals of the Order Marsupialia present a peculiar condition of dental succession, uniform throughout the order, and distinct from that of all other mammals. This peculiarity may be thus briefly expressed. The teeth of Marsupials do not vertically displace and succeed other teeth, with the exception of a single tooth on each side of each jaw. The tooth in which a vertical succession takes place is always the corresponding or homologous tooth, being the hindermost of the premolar series\*, which is preceded by a tooth having the characters, more or less strongly expressed, of a true molar.

It has been usual to divide the class Mammalia, in regard to the mode of formation and succession of their teeth, into two groups—the *Monophyodonts*, or those that generate a single set of teeth, and the *Diphyodonts*, or those that generate two sets of teeth; but even in the most typical diphyodonts the successional process does not extend to the whole of the teeth, always stopping short of those situated most posteriorly in each series. The Marsupials occupy an intermediate position, presenting as it were a rudimentary diphyodont condition, the successional process being confined to a single tooth on each side of each jaw. This position, however, is by no means without analogy among the mammals of the placental series. In the Dugong and the existing Elephants the successional process is limited to the incisor teeth. It is questionable whether the first premolar of those animals of this group which have four premolar teeth, as the Hog, Dog (mandible), &c., ever has a deciduous predecessor, at all events so far advanced as to have reached the calcified stage. But the closest analogy with the marsupial mode of succession is found among the Rodents. Here the incisors appear to have no deciduous predecessors; and in the Beaver, Porcupine, and others, which have but four teeth of the molar series, *i. e.* three true

\* The convenient distinction between false molars or premolars and true molars, is always well marked in the form of the crown, especially in the upper jaw, in the Marsupials.



molars and one premolar, the latter is, exactly as in the Marsupials, the only tooth which succeeds a deciduous tooth. The analogy, however, does not hold in those Rodents which have more than one premolar, as the Hare ; for in this case each of these teeth has its deciduous predecessor.

In the preceding account I have used the term “permanent” for those teeth which remain in use throughout the animal’s life, or, if they fall out (as do the rudimentary canines and the premolars of the *Macropodidæ*), do not give place to successional teeth ; and I have therefore assumed that the milk or temporary dentition of the typical diphyodont mammals is represented in the Marsupials only by the deciduous molars. It may be held, on the other hand, that the large majority of the teeth of the Marsupials are the homologues of the milk or first teeth of the diphyodonts, and that it is the permanent or second dentition which is so feebly represented by the four successional premolars. This view is supported by many general analogies in animal organization and development, such as the fact that the permanent state of organs of lower animals often represents the immature or transitional condition of the same parts in beings of higher organization.

Looking only to the period of development of the different teeth in some of the marsupial genera, we might certainly be disposed to place the successional premolar in a series by itself, although, indeed, all its morphological characters point out its congruity with the row of teeth among which it ultimately takes its place, the reverse being the case with its predecessor. It is, however, almost impossible, after examining the teeth of the young Thylacine described and figured in the paper, to resist the conclusion originally suggested. The unbroken series of incisors, canines, premolars, and anterior true molars of nearly the same phase of development, with posterior molars gradually added as age advances, form a striking contrast to the temporary molar, so rudimental in size, and transient in duration. I can scarcely doubt that the true molars of this animal would be identified by every one as homologous with the true molars of the diphyodonts, which are generally regarded as belonging to the permanent series, although they never have deciduous predecessors. Now, if the homology between the true molars of the Thylacine and those of a Dog, for instance, be granted, and if the anterior teeth (incisors, canines, and premolars) of the Thylacine be of the same series as its own true molars, they must also be homologous with the corresponding permanent teeth of the Dog.

It may be objected to this argument, that the true molars of the diphyodonts, not being successional teeth, ought to be regarded as members of the first or milk-series ; but, in truth, the fact that they have themselves no predecessors does not make them serially homologous with the predecessors of the other teeth, while their morphological characters, as well as their habitual persistence throughout life, range them with the second or permanent series.

We have been so long accustomed to look upon the second set of teeth as an after-development or derivative from the first, that it

appears almost paradoxical to suggest that the milk- or deciduous teeth may rather be a set superadded to supply the temporary needs of mammals of more complex dental organization. But it should be remembered that, instead of there being any such relation between the permanent and the milk-teeth as that expressed by the terms "progeny" and "parent" (sometimes applied to them), they are both (if all recent researches into their earlier development can be trusted) formed side by side from independent portions of the primitive dental groove, and may rather be compared to twin brothers, one of which, destined for early functional activity, proceeds rapidly in its development, while the other makes little progress until the time approaches when it is called upon to take the place of its more precocious *locum tenens*.

Many facts appear to point to the milk-teeth as being the less constant and important of the two sets developed in diphyodont dentition. Among these the most striking is the frequent occurrence of this set in a rudimentary and functionless or, as it were, partially developed state. The milk-premolars of some Rodents (as the Guinea-pig), shed while the animal is *in utero*, the simple structure and evanescent nature of the milk-teeth of the Bats, Insectivores, and Seals, the diminutive first incisors of the Dugongs and Elephants, all appear to be cases in point. On the other hand, examples of the commencing or sketching out, as it were, of the successors to a well-formed, regular, and functional first set of teeth, are rarely, if ever, met with. Occasional instances of the habitual early decadence, or, perhaps, absence of some of the second or so-called permanent teeth occur in certain animals; but these are rather examples of the disappearance or suppression of organs of which there is no need in the economy, and chiefly occur in isolated and highly modified members of groups in the other members of which the same phenomenon does not occur, as in *Cheiromys* among the Lemurs, *Trichechus* among the Seals, and the recent Elephants (as regards the premolars) among the Proboscideans. They form no parallel to the cases mentioned above of the rudimentary formation of an entire series of teeth of the temporary or milk-set.

To return to the Marsupials:—If this view be correct, I should be quite prepared to find, in phases of development earlier than those yet examined, some traces either of the papillary, follicular, or sacular stages of milk-predecessors to other of the teeth besides those determinate four in which, for some reason at present unexplained, they arrive at a more mature growth\*. Such proof as this would alone decide the truth of these speculations; and I have not at present either the requisite leisure or materials for following out so delicate an investigation. I trust that the facts already elicited are sufficiently novel and important to justify my bringing them, as they now stand, before the Society.

\* It may be remarked that the milk-tooth which alone is developed in the Marsupials corresponds homologically with that which, as a general rule, is most persistent in the typical diphyodonts, including Man, viz. the posterior milk-molar, replaced by the posterior permanent premolar.



May 16, 1867.—William Bowman, Esq., V.P., in the Chair.

“Further Observations on the Structure and Affinities of *Eozoon Canadense*.” (In a Letter to the President.) By WILLIAM B. CARPENTER, M.D., F.R.S., F.L.S., F.G.S.

University of London, May 9th, 1867.

When, on the 14th of December 1864, I addressed you on the subject of the remarkable discovery which had been recently made in Canada, and submitted by Sir William Logan to myself for verification, of a fossil belonging to the Foraminiferal type, occurring in large masses in the Serpentine-limestones intercalated among Gneissic and other rocks in the Lower Laurentian formation, and therefore long anterior in Geological time to the earliest traces of life previously observed, no doubts had been expressed as to the *organic* nature of this body, which had received the designation *Eozoon Canadense*.

The announcement was soon afterwards made, that the Serpentine Marble of Connemara, employed as an ornamental marble by builders under the name of “Irish Green,” presented structural characters sufficiently allied to those of the Laurentian Serpentine of Canada to justify its being referred to the same origin. An examination of numerous decalcified specimens of this rock led me to the conclusion that, although the evidences of its organic origin were by no means such as to justify, or even to suggest, such a doctrine, if the structure of the Canadian *Eozoon* had not been previously elucidated, yet the very exact correspondence in size and mode of aggregation between the Serpentine-granules of the Connemara Marble and those of the ‘acervuline’ portion of the Canadian was sufficient to justify in behalf of the one the claim which had been freely conceded in regard to the other.

In the following summer, however, it was announced in the ‘Reader’ (June 10, 1865) by Professors King and Rowney of Queen’s College, Galway, that having applied themselves to the study of the Serpentine-Marble of Connemara with a full belief in its organic origin, they had been gradually led to the conviction that its structure was the result of chemical and physical agencies alone, and that the same explanation was applicable to the supposed *Eozoon Canadense* of the Laurentian Serpentine. This view was afterwards fully set forth in a Paper “On the so-called Eozoonal Rock,” read at the Geological Society on the 10th of January 1866, and published (with additions) in the Quarterly Journal of the Geological Society for August 1866. The following is their own Summary of their conclusions (p. 215):—“It has been seen (1) that the ‘chamber-casts’ or granules of serpentine are more or less simulated by chondrodite, coccolite, pargasite, &c., also by the botryoidal configurations common in Permian Magnesian Limestone; (2) that the ‘intermediate skeleton’ is closely represented, both in chemical composition and other conditions, by the matrix of the above and other minerals;



(3) that the 'proper wall' is structurally identical with the asbestiform layer which frequently invests the grains of chondrodite—that, instead of belonging to the skeleton, as must be the case on the eozoonal view, it is altogether independent of that part, and forms, on the contrary, an integral portion of the serpentine constituting the 'chamber-casts,' under the allomorphic form of chrysotile, and that perfectly genuine specimens of it, completely simulating *casts* of separated nummuline tubules, occur in true fissures of the serpentine-granules; (4) that the 'canal-system' is analogous to the imbedded crystallizations of native silver and other similarly conditioned minerals, also to the coralloids imbedded in Permian Magnesian Limestone; that its typical Grenville form occurs as metaxite, a chemically identical mineral imbedded in saccharoidal calcite; (5) that the type examples of 'casts of stolon-passages' are isolated crystals apparently of pyrosclerite. Furthermore, considering that there has been a complete failure to explain the characters of the so-called internal casts of the 'pseudopodial tubules' and other 'passages' on the hypothesis of ordinary mechanical or chemical infiltration, also bearing in mind the significant fact that the 'intermediate skeleton,' in Irish and other varieties of eozoonal rock, contains modified examples of the 'definite shapes' more or less resembling the crystalline aggregations and prismatic lumps in primary saccharoidal marbles—that eozoonal structure is only found in metamorphic rocks belonging to widely separated geological systems, never in their unaltered sedimentary deposits,—taking all these points into consideration, also the arguments and other evidences contained in the present memoir, we feel the conclusion to be fully established, that every one of the specialities which have been diagnosed for *Eozoon Canadense* is solely and purely of crystalline origin: in short, we hold, without the least reservation, that from every available standing point—foraminiferal, mineralogical, chemical, and geological—the opposite view has been shown to be utterly untenable."

Considering that the Foraminiferal characters of *Eozoon Canadense* had been unhesitatingly accepted by all those zoologists, Continental as well as British, whose special acquaintance with the group gave weight to their opinion, it might have been prudent, as well as becoming, on the part of the Galway Professors, to express themselves somewhat less confidently in regard to its purely mineral origin. The case they made out would not have lost any of its real strength if they had simply put forward their facts as affording valid grounds for *questioning* the received doctrine; and a way of escape would have been left for them, if the progress of research should happen to bring to light conclusive evidence on the other side.

Although such conclusive evidence is now producible, it may be well for me briefly to point out what I regard as the fundamental fallacies in the argument of Professors King and Rowney.

In the first place, the Serpentine-Marble of Connemara, on which their investigations had been chiefly conducted, is admitted by every one who has examined it to have undergone a considerable amount of metamorphic change. To myself, as well as to Professors King and Rowney, the evidence which it presents of the operation of chemical and physical agencies is most obvious and conclusive; whilst the evidence of its organic origin rests entirely on its partial analogy to the eozoneal rock of Canada. Hence an entire surrender might be made of the organic hypothesis as regards the Connemara marble, without in the least degree invalidating the claim of the eozoneal rock of Canada to an organic origin. But, on the other hand, if the latter claim can be sustained, it may be fairly extended to the "Irish Green," should the evidence of similarity be found sufficient to justify such an extension, since it must be admitted by every petrologist that no amount of purely mineral arrangement in a metamorphic rock can disprove its claim to organic origin, if that claim can be shown to be justified by distinct traces, in other parts of the same formation, of organisms adequate to its production. The Carboniferous Limestone, various members of the Oolitic and Cretaceous formations, and the Hippurite and Nummulitic Limestones, all exhibit in parts an entire absence of organic structure, which is yet so distinct elsewhere as to justify the generalization that their materials have been originally separated from the ocean-waters by animal agency. And it is well known to those who have studied the changes which recent Coral-formations have undergone when upraised above the sea-level, that a complete conversion of a mass of Coral into a subcrystalline Limestone not distinguishable from ordinary Carboniferous Limestone, may take place under circumstances in no way extraordinary.

It is, therefore, upon the character of the Serpentine-Limestone of *Canada*, not upon the nature of the Connemara Marble, that the question of organic origin entirely turns; and, as I have elsewhere shown in detail\*, the hypothesis of Professors King and Rowney altogether fails to account for the *combination of phenomena* which the former presents, whilst the accordance of that combination with the idea of its Organic origin (a very moderate allowance being made for the effects of metamorphic change) is such as to establish the same kind of probability in its favour as that which we derive in the case of the Human origin of the "flint implements" from the cumulative evidence of their succession of fractured surfaces, or in the case of the chemical composition of the sun from the precise correspondence between certain dark lines in the solar spectrum and groups of bright lines produced in a dark spectrum by the combustion of certain known metals.

I may stop to point out, however, that Professors King and Rowney do not attempt to offer any feasible explanation of the fundamental fact of the regular alternation of lamellæ of Calca-

\* Quarterly Journal of the Geological Society, August, 1866.



reous and Siliceous minerals, often amounting to fifty or more of each kind, extending through a great range of area, nor of the fact that not only is this arrangement the same, though the siliceous mineral may be Serpentine in one place, Pyroxene in another, or Loganite in another, whilst the calcareous may be Calcite in one part and Dolomite in another, but that these variations may occur in one and the same specimen, the structural arrangement being continuous throughout.

And in what they state of the peculiar lamella forming the proper wall of the chambers, which I have designated the "nummuline layer," they have fallen into errors of fact so remarkable, that I can only account for them by the belief that when their paper was written they knew this layer only by decalcified specimens, and had never seen it in thin transparent sections. For they describe it as composed of parallel fibres of chrysotile packed together without any intermediate substance; whereas I have distinctly proved that the siliceous fibres are imbedded in a calcareous matrix, which I therefore feel justified in regarding as a finely tubulated Nummuline shell, of which the tubuli that were originally occupied by pseudopodia have been permeated by siliceous infiltration.

So, again, while asserting that by no conceivable process could the animal substance originally occupying these tubuli have been replaced by siliceous minerals, they have entirely ignored the fact stated by me, that this very replacement has taken place in recent specimens in my possession—a fact on the basis of which the reconstruction of the animal of *Eozoon* proposed by Dr. Dawson and myself securely rests.

The question may now, I believe, be regarded as conclusively settled by the recent discovery, in a sedimentary limestone of the Lower Laurentian formation at Tudor in Canada, of a specimen of *Eozoon* presenting characters that cannot, in the opinion of the most experienced palæontologists and mineralogists, be accounted for on any other hypothesis than that of its organic origin. For, in the first place, the occurrence of a calcareous framework or skeleton in a matrix of sedimentary limestone, which also fills up its interspaces, altogether excludes the hypothesis that this framework might be the product of any kind of pseudomorphic arrangement produced by the separation of calcareous and siliceous minerals from a solution containing both. And, secondly, this specimen exhibits that which had not previously been distinctly seen in any other, viz. a distinctly limited contour, formed by the curving downwards and closing-in of the septa, in a manner as perfect and characteristic as the closing-in of the successive chambers of any polythalamous shell. I believe that no palæontologist familiar with Palæozoic fossils would have hesitated to pronounce this specimen a fossil Coral allied to *Stromatopora*, if it had occurred in a Silurian Limestone.

That this specimen, though differing greatly in appearance



from the ordinary Serpentinous *Eozoon*, really represents that organism, is shown not merely by the general arrangement of the calcareous lamellæ, but by their minute structure. This, it is true, is far less characteristically seen in thin sections microscopically examined than it is in the specimens whose cavities have been filled up by Serpentine, the texture of which is often so marvellously little changed as to have all the appearance of recent shell-substance; but the alteration which the shelly layers have undergone in this specimen is precisely paralleled by that which I have been accustomed to find in the best-preserved specimens of other organic structures contained in the more ancient limestones. And there are still distinctly recognizable traces of the canal-system imperfectly injected with black substance, which correspond with those of the ordinary Serpentinous *Eozoon*.

For the imperfection of the specimen in this respect, however, full compensation is made in the perfect preservation of the canal-system in a small fragment of *Eozoon* long since observed by Dr. Dawson in a crystalline limestone at Madoc. This specimen having been placed in my hands by Sir William Logan, with permission to treat it in any way that should enable me to make a thorough examination of it, I have succeeded in finding in it most complete and beautiful examples of the canal-system, presenting varieties of size and distribution exactly parallel to those with which I am familiar in the Serpentine-specimens. Now, as there is not in the Madoc, any more than in the Tudor specimen, any such combination of different minerals as has been supposed by Professors King and Rowney to have given origin to the arborescent forms of the canal-system of *Eozoon* (which they have likened to moss-agate or crystallized silver), there can be no longer any reasonable ground for disputing the essential similarity of this canal-system to that first described by myself in *Calcarina*, with which it was originally compared by Dr. Dawson\*.

The extension of the inquiry into the character of the Serpentine limestones intercalated among the Gneissic and other rocks of Laurentian age in various parts of Europe, has brought to light such numerous examples of eozoonal structure, more or less distinctly preserved, as to afford strong grounds for the conclusion that this organism was very generally diffused at that epoch, and performed much the same part, in raising up solid structures in the waters of the ocean, that the Coral-forming Zoophytes perform at the present time. I had myself examined before the close of 1865 specimens of Ophicalcite from Cesha Lipa in Bohemia and from the neighbourhood of Moldau, in which an eozoonal structure was distinctly traceable; and early in 1866 a more extended series was transmitted to me through Sir C. Lyell from Dr. Gümbel, the Government Geologist of Bavaria, in which I was able to

\* A full description of these specimens by Dr. Dawson, with a notice of their stratigraphical position by Sir William Logan, has been read at the Geological Society, on the 8th of May, 1867.

trace a continuous gradation, from specimens in which the eozoonal structure was distinct, to others in which, if it ever existed, it had been completely obscured by subsequent metamorphism. The results of a very careful and complete examination of the Ophicalcites of Bavaria by Dr. Gümbel himself have been communicated to the Royal Academy of Munich\*.

Appearances of the same character are presented by a series of specimens of the Serpentinous Limestones from the Primitive Gneiss of Scandinavia, kindly transmitted to me by Prof Lovén.

I venture to hope that the foregoing *résumé* of the present aspect of this subject will be of interest to the Fellows of the Royal Society. I say the *present* aspect, because I am strongly convinced that we are at present only at the beginning of our knowledge of this and other ancient types of Foraminiferal structure, and that careful search in promising localities will bring to light many wonders now lying unsuspected in the vast aggregate of pre-Silurian strata.

May 23, 1867.—Lieut.-General Sabine, President, in the Chair.

“*Ovibos moschatus* (Blainville).” By W. BOYD DAWKINS, M.A., F.G.S.

*Ovibos moschatus*, more commonly known as the musk-ox, has been described under different names by naturalists as their opinions fluctuated concerning its affinities with the ox, buffalo, or sheep. It is called the musk-ox by all the arctic explorers, *Bos moschatus* by Schreber, Zimmermann, Pennant, and Cuvier, musk-buffalo allied to the *Bubalus caffer* of South Africa by Professor Owen, *Ovibos moschatus* by De Blainville, Desmarest, Richardson, and M. Lartet. That the latter four naturalists are right in the place they assign to it in the zoological scale, intermediate between *Ovis* and *Bos*, is proved both by the natural history and the osteology of the animal. The absence of a muffle and dewlap, the hairiness of the nostrils, the shortness of tail and smallness of ear, and the possession of two teats only, separate the animal from *Bos* and connect it with *Ovis*, while the large size and long gestation of nine months differentiate it from the latter animal. Precisely the same evidence is afforded by its skeleton. In the skull, the tapering of the anterior portion, the prominence of the orbit, the verticality of the facial plate of the maxillary, the presence of a larmier, the squareness of the basisphenoid, the presence of the occipito-parietal suture on the coronal surface—in the dentition the sharpness of the costæ 1, 2, and 3, and the absence of the accessory column from the inner interspace of the lobes of the upper teeth, are among the chief ovine characters; and throughout the skeleton the same ovine tendency is manifested.

\* “Ueber das Vorkommen von Eozoon im ostbayerischen Urgebirge,” aus d. Sitzungsber. d. k. Acad. d. W. in München, 1866, i. 1.



With the exception of the great development of the horns, there is no point in common between it and *Bubalus caffer*. The encroachment of the horn-cores on the parietals differentiates it from the sheep.

The animal ranges at the present day from Fort Churchill, lat. 60°, northwards as far as the arctic sea, and eastwards as far as Cape Bathurst, lat. 71°, living for the most part on the "barren grounds," and never penetrating far into the woods. In geological times, however, it had a far greater range eastwards and southwards. In the pleistocene river-gravels lying on the solid ice in Eschscholtz Bay, in Russian America, it is found associated with the elk, reindeer, bison, horse, and mammoth. Traces of the animal ranging further to the east are afforded by the skull found on the banks of the Yena, in lat. 70°, long. 135°. Dr. Pallas's discovery of two skulls on the banks of the Obi brings the animal still closer to the borders of Europe. All three skulls were found in the "Tundas," or treeless "barren grounds" of Siberia, in the same series of gravels which afford such vast stores of fossil ivory. In Germany it has been found in three localities; and in France, in the valley of the Oise, it is associated with flint implements of the St. Acheul type, and with the mammoth and *Elephas antiquus*. It has also been found in the reindeer-caves of Périgord, under circumstances that prove beyond doubt that the animal was eaten by the reindeer-folk. In England it has been found in three gravel-beds of late pleistocene age, near Maidenhead, at Freshford near Bath, and at Greenstreet-green near Bromley. In 1866 the author dug it out of the lower brick-earth of Crayford in Kent, where it was associated with *Rhinoceros megarhinus*, *R. leptorhinus* (Owen), and *Elephas antiquus*. The skull in this latter case belonged to a remarkably fine old male. Thus its present limited range in space contrasts most strongly with its wide range in pleistocene times through North Siberia and Central Europe north of a line passing through the Alps and Pyrenees. Its association with animals of a temperate or else southern zone is to be accounted for by its having been driven from its usual haunts by an unusually severe winter. The rarity of its remains proves that it was not so abundant as those animals which are associated with it in France, Germany, and Britain.

Professor Leidy figures and describes two fossil skulls most closely allied to *Ovibos moschatus*, from Arkansas and Ohio, under the name of *Bootherium cavifrons* and *B. bombifrons*; they are, however, most probably the male and female of the same species. They differ from *Ovibos moschatus* only in the direction of their horn-cores, and in their bases meeting and becoming fused on the coronal surface of the male skull. The horn-cores are supported both by the frontals and parietals. In other respects they present the same ovine affinities as *Ovibos*; and certainly belong to the same genus.